



## Range extension of *Lonchophylla peracchii* (Chiroptera, Phyllostomidae) to Northeastern Brazil

Daniela Dias<sup>1\*</sup>, Carlos Eduardo Lustosa Esbérard<sup>2</sup> and Ricardo Moratelli<sup>3</sup>

1 Laboratório de Biologia e Parasitologia de Mamíferos Silvestres Reservatórios, Instituto Oswaldo Cruz, Fundação Oswaldo Cruz. CEP 21040-900, Rio de Janeiro, RJ, Brazil

2 Laboratório de Diversidade de Morcegos, Instituto de Biologia, Universidade Federal Rural do Rio de Janeiro. CEP 23890-000, Seropédica, RJ, Brazil

3 Campus Fiocruz da Mata Atlântica, Fundação Oswaldo Cruz. CEP 22713-375, Rio de Janeiro, RJ, Brazil

\* Corresponding author. E-mail: [diasdani74@gmail.com](mailto:diasdani74@gmail.com)

**Abstract:** *Lonchophylla peracchii* was recently described from Rio de Janeiro Atlantic Forest samples previously assigned to either *L. bokermanni* Sazima, Vizotto & Taddei, 1978 or *L. mordax* Thomas, 1903. The species is currently restricted to the Atlantic Forest of Southeastern Brazil. Based on museum specimens, we extend the species distribution to the Atlantic Forest of Northeastern Brazil. The specimens reported here were collected in Ilhéus, Bahia state, representing a range extension of ca. 500 km northward.

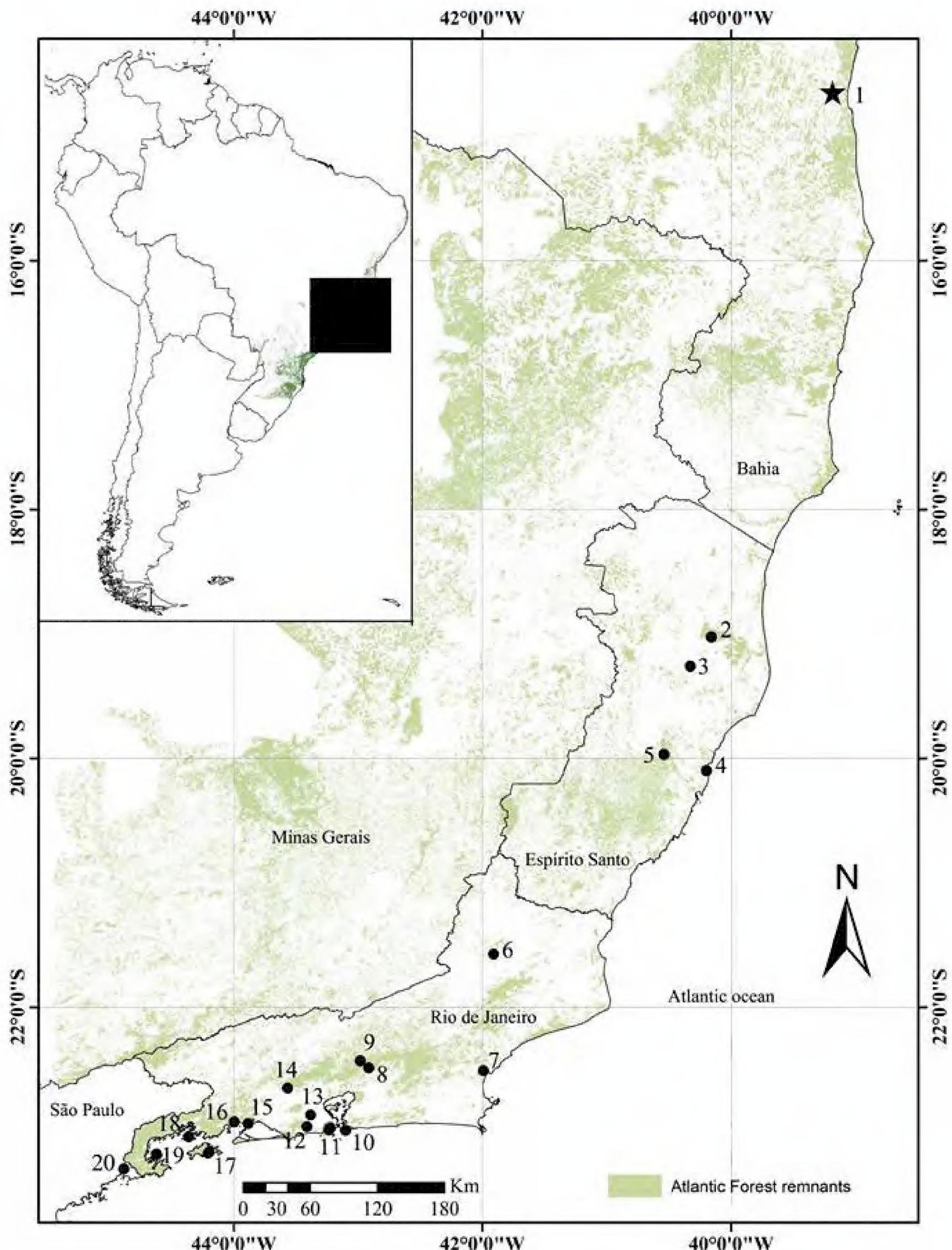
**Key words:** Atlantic Forest; geographic distribution; *Lonchophylla*; Northeastern Brazil

The genus *Lonchophylla* Thomas, 1903 occurs from southern Nicaragua to southeastern Brazil (Griffiths and Gardner 2008; Parlos et al. 2014). Thirteen species are currently recognized, five of them in Brazil (Dias et al. 2013; Parlos et al. 2014; Moratelli and Dias 2015). *Lonchophylla mordax* Thomas, 1903 occurs in the Atlantic Forest, Caatinga, and ecotones of these two biomes in Northeastern Brazil (Moratelli and Dias 2015); *L. dekeyseri* Taddei, Vizotto & Sazima, 1983 occurs sparsely along the Caatinga and Cerrado of Midwestern and Northeastern Brazil, and Eastern Bolivia (Griffiths and Gardner 2008; Aguiar et al. 2010; Leal et al. 2013); *L. bokermanni* Sazima, Vizotto & Taddei, 1978 is endemic to the Cerrado of Southeastern Brazil, with records for three localities in Minas Gerais (Dias et al. 2013; Nascimento et al. 2013; Teixeira et al. 2014a); *L. inexpectata* Moratelli & Dias, 2015 occurs in the Caatinga of Northeastern Brazil, with confirmed records from Pernambuco and Bahia (Moratelli and Dias 2015); and *L. peracchii* Dias, Esbérard & Moratelli, 2013 is currently restricted to Southeastern Brazil, with confirmed records from Rio

de Janeiro, Espírito Santo and São Paulo (Pimenta et al. 2010; Nascimento et al. 2013; Dias et al. 2013; Teixeira et al. 2013) (Figure 1; Table 1).

*Lonchophylla peracchii* was described from Rio de Janeiro Atlantic Forest samples previously assigned to either *L. bokermanni* or *L. mordax* (see Dias et al. 2013). The species is currently restricted to the Atlantic Forest of Southeastern Brazil and occurs in lowland and mountainous evergreen and semideciduous forests (0–1000 m of elevation), pioneer formations, and islands near the continent (Pimenta et al. 2010; Dias et al. 2013; Teixeira et al. 2013). As part of a taxonomic review of *Lonchophylla* collections from Brazil, we found museum specimens from the Atlantic Forest of Northeastern Brazil, which extend the geographic distribution of *L. peracchii* northward.

Eleven fluid-preserved specimens, four of them with skulls removed, support the range extension of *L. peracchii*. They are deposited in the mammal collection of Museu Nacional, Universidade Federal do Rio de Janeiro (MNRJ), Rio de Janeiro, Brazil. The series comprises four adult males (MN 43349, 47448, 46614, 46615) and seven adult females (MN 46611, 46612, 46613, 46616, 46617, 46618, 47447) collected in 1944 on the Almada (14°39' S, 039°11' W), Rio do Braço, Ilhéus, Southern region of Bahia, Brazil (Figure 1). Almada was one of the stations selected for sampling mosquitoes and mammals during investigations of the project “Studies and Research Service on Yellow Fever”, which was part of a study on wild mammals and jungle yellow fever, developed in cooperation with the International Health Division of the Rockefeller Foundation. Fieldwork was conducted from December 1943 to April 1945, in Ilhéus and Buerarema (Laemmert et al. 1946; Vaz 2005). According to reports from that time, the vegetation was primarily composed by remnants of



**Figure 1.** Geographic distribution of *Lonchophylla peracchii*. Black star: new record for the Northeast of Brazil (Ilhéus, Bahia); black circles: literature records. The numbers corresponding to the records are indicated in the Table 1.

secondary forest regeneration, surrounded by extensive cocoa plantations and flooded vegetation (Veloso 1946; Laemmert et al. 1946; Vaz 2005).

Identification was based on the diagnostic characters reported by Dias et al. (2013). We measured the forearm length (FA) of all specimens, from the elbow to the distal end of the forearm, including carpals, with the wing partially folded. For those specimens that had the skulls

removed, eleven cranial dimensions (Table 2) were taken following Sazima et al. (1978). Measurements (in mm) reported here were taken using a digital caliper accurate to 0.01 mm, but values were rounded to 0.1 mm throughout the text because this is the smallest unit that allows accurate repeatability with calipers (Voss et al. 2013).

The specimens from Ilhéus have the set of diagnostic characters that fit in the description of *L. peracchii*

**Table 1.** Locality records for *Lonchophylla peracchii*. An asterisk indicates the new record from Northeastern Brazil. BA = Bahia; ES = Espírito Santo; RJ = Rio de Janeiro; SP = São Paulo.

Number	Coordinates	State	Municipality	Locality	Reference
1*	14°39' S, 039°11' W	BA	Ilhéus	Almada Station	This study
2	19°01' 32"S, 040° 09' 34" W	ES	Sooretama	Reserva Biológica de Sooretama	Pimenta et al. (2010)
3	19°15' 36" S, 040°19' 48" W	ES	Santo Izidório	Rio Bananal	Nascimento et al. (2013)
4	19°58' 12" S, 040°32' 24" W	ES	Santa Teresa	Estação Biológica de Santa Lúcia	Nascimento et al. (2013)
5	20°06' 00" S, 040°12' 00" W	ES	Santa Leopoldina	Pedra Suíça	Nascimento et al. (2013)
6	21°34' 31.00"S, 041°54' 40.00" W	RJ	Cambuci	Cambuci	Dias et al. (2013)
7	22° 29' 96" S, 041°58' 92" W	RJ	Casimiro de Abreu	Morro de São João	Dias et al. (2013)
8	22°29' 22.20"S, 042°54' 50.30" W	RJ	Guapimirim	Estação Ecológica Estadual Paraíso	Novaes et al. (2010)
9	22°26' S, 042°59' W	RJ	Teresópolis	Parque Nacional da Serra dos Órgãos	Dias et al. (2013)
10	22°57' 55.77"S, 043°13' 36.01" W	RJ	Rio de Janeiro	Jardim Botânico	Dias et al. (2013)
11	22°59' 20.65"S, 043°14' 02.39" W	RJ	Rio de Janeiro	Parque do Penhasco	Dias et al. (2013)
12	22°52' S, 043°23' W	RJ	Rio de Janeiro	Parque Estadual da Pedra Branca	Dias et al. (2013)
13	22°57' 40.60"S, 043°24' 42.72" W	RJ	Rio de Janeiro	Floresta da Tijuca	Dias et al. (2013)
14	22°39' S, 043°34' W	RJ	Nova Iguaçu	Reserva Biológica do Tinguá	Dias et al. (2013)
15	22°56' 11"S, 043°53' 04" W	RJ	Mangaratiba	Ilha de Itacuruçá	Dias et al. (2013)
16	22°59' 26.4"S, 043°06' 03.2" W	RJ	Mangaratiba	Reserva Rio das Pedras	Dias et al. (2013)
17	23°10' S, 044°12' W	RJ	Angra dos Reis	Ilha Grande	Taddei et al. (1988); Dias et al. (2013)
17	23°10' 33.5"S, 044°12' 27.8" W	RJ	Angra dos Reis	Ilha Grande	Dias et al. (2013)
18	23°02' 29.03"S, 044°21'43.77" W	RJ	Angra dos Reis	Ilha da Gipóia	Dias et al. (2013)
19	23°10' 55.73"S, 044°38' 15.30" W	RJ	Parati	Praia do Sono	Dias et al. (2013)
20	23°18' S, 044°53' W	SP	Ubatuba	Picinguaba, Serra do Mar State Park	Teixeira et al. (2013)

**Table 2.** Measurements (mm) of the *Lonchophylla peracchii* specimens from Brazilian Atlantic Forest. BA = Bahia; ES = Espírito Santo; RJ = Rio de Janeiro; SP = São Paulo.

Measurements	Ilhéus, BA <sup>1</sup>	Sooretama, ES <sup>2*</sup>	Santa Teresa, Santo Izidório and Santa Leopoldina (pooled), ES <sup>3*</sup>	Atlantic Forest pooled localities, RJ <sup>4</sup>	Picinguaba, Ubatuba, SP <sup>5</sup>
Forearm length	33.2–35.9	35.9	34.2–36.6	34.5–36.9	36.3
Greatest length of skull (including incisors)	21.8–23.2	24.5	23.3–23.9	23.8–25.4	25.1
Condyllo-incisive length	20.6–22.0	—	23.0–23.5	22.7–24.6	24.1
Basal length	18.8–19.9	20.7	20.6–21.1	20.2–22.7	22.0
Maxillary toothrow length	6.8–7.3	7.5	7.3–7.9	7.5–8.4	8.1
Breadth across molars	4.7–5.0	5.0	4.9–5.1	4.8–5.8	4.9
Breadth across canines	3.6–3.8	3.8	3.4–3.8	3.5–4.1	4.1
Postorbital breadth	4.5–4.7	4.7	4.4–4.8	4.4–5.0	4.8
Braincase breadth	8.7–8.9	9.2	8.7–8.9	8.4–9.6	9.3
Mastoid breadth	8.8–9.3	9.5	8.8–9.2	8.5–9.7	9.4
Mandibular toothrow length	7.2–7.8	7.9	7.8–8.1	8.0–8.8	8.5
Mandibular length	14.3–15.5	16.3	16.0–16.5	16.0–17.8	17.3

<sup>1</sup>N = 4 males and 7 females (cranial measurements for 1 male and 3 females) (present study); <sup>2</sup>N = 1 male (Pimenta et al. 2010); <sup>3</sup>N = 2 males and 1 female (Nascimento et al. 2013); <sup>4</sup>N = 36, males and females pooled (Dias et al. 2013); <sup>5</sup>N = 1 male (Teixeira et al. 2013); \*specimens cited as *L. bokermanni*.

provided by Dias et al. (2013). They have the proximal portion of the dorsal surface of the forearm covered with fur; ventral fur brownish, weakly bicolored, with dark brown bases and paler brown tips, contrasting slightly with the dorsal fur; medium-sized ear with narrow tip; tragus spatulated with rounded tip; upper inner incisors elongated, spatulated, and procumbent; upper outer incisors small, slender, and pointed, separated from canines by large gaps; upper canines long and distinctly grooved along the anterior surface; and upper premolars triangular in lateral view.

The four skulls we examined (MN 43349, 46611, 46613, 46615) show the following set of traits: supraorbital region and nasals not inflated; posterior margin of the

infraorbital foramen not projected beyond the lateral outline of the rostrum; posteromedial edge of the palate positioned posteriorly to the posterior border of the optic foramen; pterygoid processes narrow and divergent; basisphenoid pits shallow, with intervening septum broad; dentary long and slender; coronoid process low, with rounded tip slightly above the line of the articular condyle; posterior border of the infraorbital foramen (in lateral view) between the posterior root of P<sub>4</sub> and anterior root of M<sub>1</sub> (MN 46611, 46613, 46615) or above the anterior root of M<sub>1</sub> (MN 43349); and long, open, and U-shaped (MN 43349, 46613) or V-shaped mesopterygoid fossa (MN 46611). Additionally, the last upper premolar (P<sub>4</sub>) has an inner lobe reduced and lingual root displaced

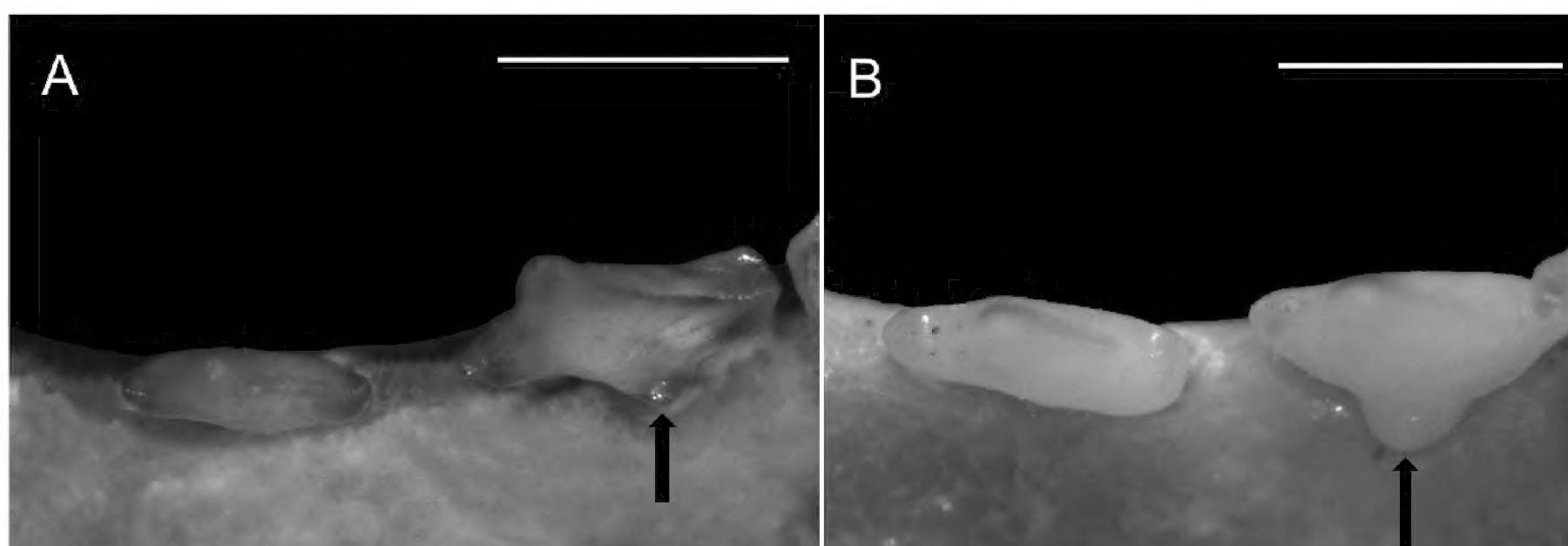
posteriorly (Figure 2A); the mesostyle is reduced in the first ( $M_1$ ) and second ( $M_2$ ) upper molars; the parastyles of  $M_1$  and  $M_2$  are poorly to moderately developed and labially oriented, in occlusal view; and the metastyles of  $M_1$  and  $M_2$  are poorly developed (Figure 3A).

We found variations in the proportion of the upper and lower premolars, compared to samples from Rio de Janeiro and São Paulo. In the four specimens from Ilhéus, the first upper premolar ( $P_3$ ) is narrow in occlusal view, as well as in the specimens from Rio de Janeiro and São Paulo. However, in the specimens from Ilhéus,  $P_3$  is lower than  $P_4$  in labial view. Additionally, in these specimens, the third lower premolar ( $p_3$ ) is slightly reduced compared to the first ( $p_1$ ) and second premolars ( $p_2$ ). In contrast, the upper and lower premolars are sub-equal in size in the samples from Rio de Janeiro and São Paulo. Skull measurements, particularly related to the length of skull, are generally smaller than those from specimens from Espírito Santo, Rio de Janeiro and São Paulo, suggesting a slight trend in size increase from north to south (Table 2), which seems to be a clinal variation.

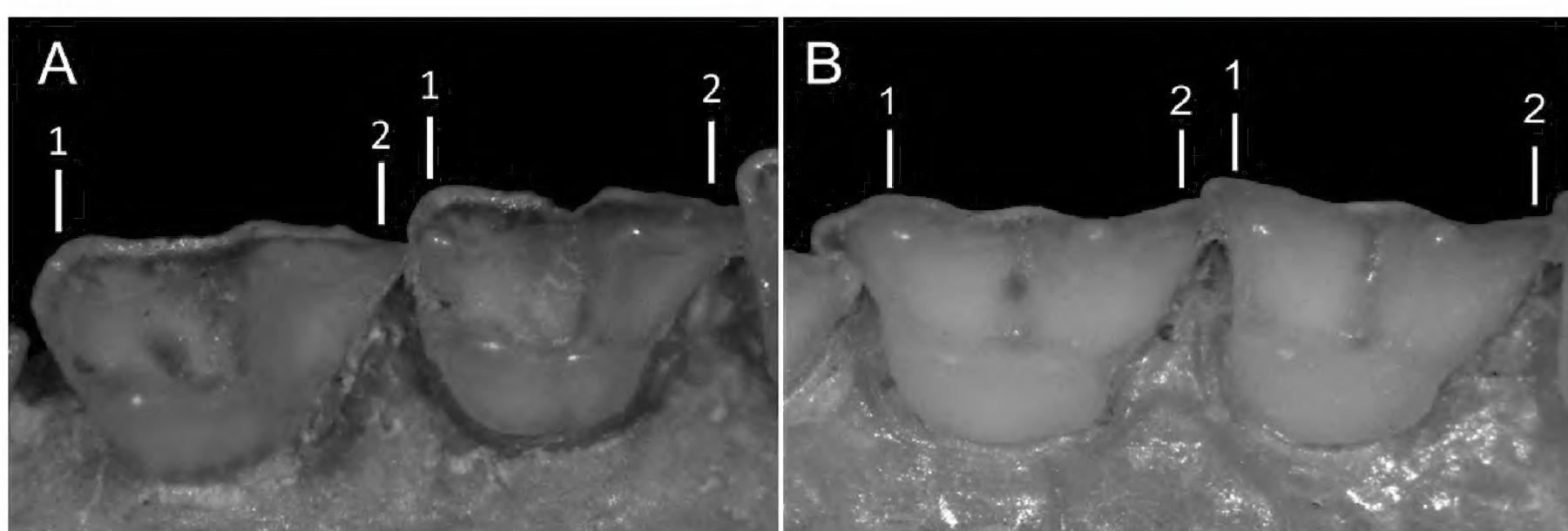
Laemmert et al. (1946) assigned the specimens from Ilhéus to *L. mordax*, the sole *Lonchophylla* species known

from Brazil at that time. *Lonchophylla mordax* overlaps in size with *L. peracchii*, but can be distinguished from this species by presenting the following combination of character states: proximal portion of the forearm naked; basisphenoid pits deep and separated by a narrow septum; posteromedial edge of the palate positioned anteriorly to the posterior border of the optic foramen; mesopterygoid fossa usually W-shaped; coronoid processes high, with tip nearly triangular above the line of the articular condyle; upper canines with convex anterior surface not grooved;  $P_4$  robust with inner lobe well developed and lingual root in the median portion of the tooth (Figure 2B); parastyle of  $M_1$  oriented forwardly and projected over the posterior labial margin of the  $P_4$ ; and metastyles of  $M_1$  and  $M_2$  well developed (Figure 3B).

The series from Ilhéus represents the first record of *L. peracchii* for the state of Bahia and for the Atlantic Forest of Northeastern Brazil. Before this range extension, the northernmost record for the species was in Sooretama, Espírito Santo. Even though our record extends the species distribution in ca. 500 km, these specimens were collected more than 70 years ago and the landscape



**Figure 2.** Occlusal view of the upper premolars of *Lonchophylla peracchii* from Ilhéus, Bahia (A; MN 43349) and *L. mordax* from Grotta do Angico, Sergipe (B; ALP 10088). Note the last premolar ( $P_4$ ) with a small inner lobe in *L. peracchii* and last premolar with a well-developed lobe in *L. mordax*. Scale bar: 1.0 mm.



**Figure 3.** Oblique occlusal view of the upper molars ( $M_1$  and  $M_2$ ) of *Lonchophylla peracchii* from Ilhéus, Bahia (A; MN 43349) and *L. mordax* from Grotta do Angico, Sergipe (B; ALP 10088). Note the parastyles (1) moderately developed and metastyles (2) reduced in *L. peracchii*, contrasting with parastyles and metastyles well developed and distinct in *L. mordax*.  $M_1$ - $M_2$  length:  $\approx 2.5$  mm.

must have gone through massive modifications. The forest coverage in southern Bahia has been rapidly degraded with the expansion of extensive livestock, agriculture, logging, and the replacement of forests by pasture (Araujo et al. 1998). Currently, the vegetation consists of a mosaic of primary and secondary forests and cocoa plantations under “cabrucas”, a traditional planting system where cocoa (*Theobroma cacao* L., Sterculiaceae) is grown under the shade of native canopy forest without the total removal of the trees (Araujo et al. 1998; Faria and Baumgarten 2007). Despite disturbances from changes in the original landscape, the “cabrucas” still represent complex habitats, providing roosts and foraging areas for dwelling species, serving as forest corridors. Their maintenance is important for the conservation of the bat diversity in southern Bahia, where more than 60 bat species have been recorded (Faria et al. 2006; Faria and Baumgarten 2007; Zortéa et al. 2013; Gregorin et al. 2015). Due to habitat changes, the current occurrence of *L. peracchii* in that region is an open question. Specimens assigned to *L. mordax* have been collected from localities geographically close to Ilhéus (Una and Itapebi municipalities; see Faria et al. 2006; Faria and Baumgarten 2007), and a reevaluation of the identification of these samples is advisable given the findings from recent taxonomic reassessments of the Brazilian species of *Lonchophylla* (Dias et al. 2013; Moratelli and Dias 2015).

*Lonchophylla peracchii* seems to be endemic to the Brazilian Atlantic Forest. Although this biome is minimally represented in Northeastern Brazil, it has been more intensively studied and has the highest bat species richness in the region, with more than 100 species currently recorded (see Zortéa et al. 2013; Garcia et al. 2014; Gregorin et al. 2015; Vilar et al. 2015). Due to its recent description and sparse data published on its biology, the conservation status of *L. peracchii* has not been formally assessed yet. The species has an estimated extent of occurrence of ca. 39,000 km<sup>2</sup>, which is larger than the minimum threshold of 20,000 km<sup>2</sup> for IUCN’s extent of occurrence criterion to warrant a threatened status under IUCN (Teixeira et al. 2014b). However, *L. peracchii* occurs within a biodiversity hotspot that has lost nearly 90% of its original forest coverage (Ribeiro et al. 2009; Fundação SOS Mata Atlântica 2015). In order to more accurately assess its status and support conservation actions, further information on its current distribution, ecology, and natural history are necessary. For this, we recommend a review of *Lonchophylla* museum specimens and additional fieldwork combined with environmental suitability analysis to understand its distribution and the ecological determinants of its occurrence.

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